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AUTHOR Jennings, Thomas; Dwyer, Francis M.
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ABSTRACT

The effectiveness of elaborate visual cueing and reduced step size (i.e., increasing the number of visual cues) in facilitating student achievement on different instructional tasks was examined. The hypothesis proposed that instructional treatments utilizing reduced step size and elaborate visual cueing alone and in combination would be superior to treatments using larger step size and simple visual cueing. Parts of Dwyer's instructional materials were modified and used with varying degrees of visual cueing. Simple visual cues employed were static position indicators. Dynamic-process arrows, motion indicators, and shading were used as elaborate cues. Immediate and delayed posttests were administered to 92 university students in four treatment groups, following self-paced interaction with assigned instruction presentations. Results showed that visual step size affected achievement on certain criterion tasks. Selective reduction of visual step size had an overall facilitative effect on immediate learning and on the individual drawing task, but effect was maintained only on the drawing test. Instructional treatments differing only in degree of visual cueing used were equally effective. No advantage was gained in visualized instruction by using elaborate visual cueing. Ten references are listed with this research report. (LMM)

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# THE EFFECT OF VARIED VISUAL CUEING STRATEGIES IN FACILITATING STUDENT ACHIEVEMENT ON DIFFERENT EDUCATIONAL OBJECTIVES

by

Thomas Jennings

and

Francis Dwyer

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# The Effect of Varied Visual Cueing Strategies in Facilitating Student Achievement on Different Educational Objectives

Thomas Jennings
USREP IJECOR
APO, New York 09038

Francis Dwyer
140 Chambers Building
The Pennsylvania State University
University Park, PA 16802

## Background

Early research in visualized instruction subscribed to a conceptual framework which emphasized comparisons between different media types. While this approach has generated some useful information for the selection and utilization of media types, it has done little to develop a scientific base for improving the learning effectiveness of visual materials produced by instructional designers and teachers (Lumsdaine, 1960). A serious flaw in this approach is its failure to deal with visual instructional materials as combinations of distinct cues.

A more productive approach is one which would employ a conceptual framework which would investigate the stimulus characteristics of visuals. Levie and Dickie (1973, p. 860), in a state-of-the-art report, advocated research that "...specifies the relevant variables in terms of the attributes of media rather than in terms of the media themselves." They qualified this by adding, "Media attributes are properties of stimulus materials which are manifest in the physical parameters of media." Recent research efforts have moved in this direction by dealing with the stimulus characteristics of visuals in relation to specific educational tasks (Dwyer, 1967, 1972; Trabasso and Bower, 1968; Berry, 1974; and Parkhurst, 1974).

The present study attempted to contribute to the conceptual base for visualized instruction by exploring two cueing strategies used in visuals. Specifically, its purpose was to investigate the effectiveness of elaborate visual cueing and reduced step size (increasing the number of visual cues) in facilitating student achievement on different instructional tasks.

## Hypotheses

The following hypotheses were proposed in an effort to generate information to assist designers of instructional visuals in selecting cueing techniques which are most effective for facilitating learning on specific educational tasks.

$H_1$: The instructional treatments utilizing reduced step size will be superior to the larger step size treatments in terms of facilitating student achievement on the immediate and delayed criterion tasks.

$H_2$: The instructional treatments utilizing elaborate visual cueing will be superior to the simple visual cueing treatments in terms of facilitating student achievement on the immediate and delayed criterion tasks.

$H_3$: The instructional treatment combining reduced step size with elaborate visual cueing will be superior to all other treatments in facilitating student achievement on the immediate and delayed criterion tasks.

## Experimental Treatments

Dwyer's original instructional package was used, in part, as the basis for this study. The 2,000-word script, terminology labels, and criteria measures were all retained intact. Modified versions of the black and white, simple-line-drawing sequence served as the primary presentation in this study. Modifications were made to further this study's investigation and they occurred as the result of a task analysis performed on previous research results obtained from a study conducted by Dwyer (1971). Utilizing the task analysis, four instructional treatments were designed and produced to test the hypotheses of this study.

Students in Group I received the larger step size (37 visuals), with simple visual cues (static position indicators). Students in Group II also received the 37 visuals; however, in addition they received what was considered to be elaborate cueing (dynamic-process arrows, motion indicators, and shading). Group III received reduced step size (47 visuals), with simple visual cueing (static position indicators). Group IV received the same reduced step size as did Group three; however, they also received elaborate visual cueing (dynamic-process arrows, motion indicators, and shading).

Each treatment consisted of an instructional booklet describing the human heart, its parts, and the internal processes occurring during the systolic and diastolic phases. Contained within each booklet was the 2,000-word instructional heart script accompanied by appropriate visuals of the heart. The booklets were divided into individual pages (or frames). Each page of the booklet consisted of an 8 1/2 x 11 inch sheet of white paper; occupying the top portion of the page was a 4 x 5 inch simple black-line drawing of the heart. Corresponding paragraphs of the instructional script were positioned on the lower portion of the page beneath the heart picture. Each illustration of the heart was labeled with appropriate terminology.

## Experimental Procedures

The sample population for this study consisted of 92 university students enrolled in The Pennsylvania State University. For participation in this study, and as a motivational device, all subjects received extra credit in their respective courses. Each subject was required to attend two experimental sessions. During Session I, subjects were randomly assigned to one of the four treatment groups--resulting in an $n = 23$ for each treatment group.

In Session I, subjects interacted with their assigned instructional presentations and completed four criterion tests. Before treatments were begun, subjects were arranged in separate treatment groups and told to read the directions on the cover of the instructional booklet. All subjects received the same directions. The printed information consisted of three points: (1) subjects were told that the purpose of the study was to investigate the effectiveness of visual illustrations and cueing strategies; (2) subjects were told that there was no time limit and that they, therefore, should progress at their own pace through the booklet (self-pacing); and (3) subjects would be tested on a battery of criterial tests immediately after completing the

booklet. Subjects were also told verbally that they would be retested six weeks later in Session II. The subjects than interacted with their respective instructional booklets on an individual and self-paced basis. Although no time limit was imposed, subjects were timed so that efficiency scores could be computed later. Upon completion of the treatment, each subject was asked to take the drawing, identification, terminology, and comprehension tests. Subjects were permitted to take as much time as needed for each criterion test before proceeding to the next. All data were analyzed by analysis of variance techniques to determine if statistically significant differences existed among instructional treatments.

## Statistical Analysis

The first part of the statistical analysis examined both criterion test reliabilities (K-R 20) and homogeneity of variance among treatment groups (Bartlett's Test). Following this, interpretation of the study's findings was accomplished by a randomized factorial design. Specifically, a three-factor, repeated-measure design was used with two between-subjects factors (A and B) and one within-subjects factor (C). In notation form, the design can be characterized as $(A_2 @ B_2)$ in $C_2$, indicating two levels of factor A crossed with two levels of factor B, and both A and B nested in factor C. The independent variable in the study was the method of visual cueing used, while the dependent variables were test scores on the drawing, identification, terminology, comprehension, and total criterion tests.

Factors in Experimental Design

| Between-Subjects Factors | | | |
|---|---|---|---|
| Factor A: | Step Size | Factor C: | Time/Test Administration |
| | Level $A_1$ (Larger Step Size) | | Level $C_1$ (Immediate Testing) |
| | Level $A_2$ (Reduced Step Size) | | Level $C_2$ (Delayed Testing) |
| Factor B: | Cueing Technique | | |
| | Level $B_1$ (Simple Visual Cueing) | | |
| | Level $B_2$ (Elaborate Visual Cueing) | | |

A three-way analysis of variance (ANOVR) was conducted on the number of correct responses achieved by subjects on each criterion test, as well as on their combined total criterion score. An F-ratio with a p value .05 significance level or less was considered sufficient to reject null hypotheses and to verify alternative hypotheses. An additional two-way analysis of variance (ANOVES) was performed separately on the immediate and delayed retention measures to reveal any significant findings observed by collapsing data on the within-subjects factor of the three-way analysis of variance. Efficiency scores were calculated for each treatment group and analyzed by analysis of variance (ANOVES) techniques to determine if significant statistical differences existed.

## Results

Criterion test reliabilities were obtained by calculating Kuder-Richardson Formula 20 reliability coefficients; the values obtained for the criterion tests were all of a satisfactory level (Drawing test, .84; Identification Test, .85; Terminology Test, .86; and Comprehension Test .789). Results from Bartlett's Test for homogeneity of variance conducted on the dependent variables (the criterion tests) were all non-significant at the .05 level, indicating that the subjects who received the instructional treatments could be viewed as having been drawn randomly from populations with common variance.

Based upon the data obtained in the statistical analyses of this study, the following findings were made in regard to the design of visualized learning materials. Relative to the step size of visuals within a self-paced visualized instructional sequence, it was found that:

1. Instructional treatments containing identical printed scripts and word labels, but employing different visual step sizes, were not equally effective in facilitating student achievement on certain criterion tasks.

2. In the immediate retention condition, those instructional treatments employing selective reduction of visual step size had an overall facilitative effect on learning as evidenced by the significant F-ratio of 4.1 (.05 level) for reduced size treatments on the total criterion test measure. On individual criterion tasks, selectively reduced visual step size treatments had a facilitative learning effect on drawing (significant F-ratio of 5.1 at a .05 level) but not on comprehension, identification, or terminology.

3. In the delayed retention condition, those instructional treatments employing selective reduction of visual step size had little facilitative effect on the criterion tasks. The overall learning effect present in the immediate retention condition did not occur in the delayed retention condition. Of the individual criterion tasks, only drawing appeared to be positively affected by selectively reducing visual step size.

Relative to elaborate visual cueing within a self-paced, visualized instructional sequence, it was found that:

1. Instructional treatments containing identical printed scripts and word labels, but differing in degree of visual cueing elaborateness present, were equally effective in facilitating student achievement on the criterion tasks (drawing, identification, terminology, comprehension).

2. No advantage was gained in a visualized instructional sequence by utilizing elaborate visual cueing.

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